IAEA Perspective on Management of NORM Waste

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Outline

• Challenging issues of NORM residues/waste
• Applicable requirements in IAEA Safety Standards
• Proposed regulatory framework for management of NORM residues/waste
• Way forward
What is NORM?

NORM (Naturally occurring radioactive material) definitions:

- **NORM**: Radioactive material containing no significant amounts of radionuclides other than naturally occurring radionuclides (regulatory decision & activity concentration of process material is the key)

- **NORM Residues**: Material that remains from a process and comprises or is contaminated by naturally occurring radioactive material (NORM).

- **NORM waste**: Naturally occurring radioactive material for which no further use is foreseen.

Therefore, a NORM residue may - or may not - be waste.

*Source - IAEA Safety Glossary 2007 Edition*
Challenging issues
– Global existence and wide sectors

1. Uranium mining and processing
2. Rare earths extraction
3. Thorium extraction & use
4. Niobium extraction
5. Non-U mining – incl. radon
6. Oil and gas
7. TiO₂
8. Phosphates
9. Zircon & zirconia
10. Metals production (Sn, Cu, Al, Fe, Zn, Pb)
11. Burning of coal etc.
12. Water treatment – incl. radon
Challenging issues
– resources rather than waste

• Increasing recognition of NORM residues as resource rather than waste but vulnerable due to very dynamic, public acceptance, possible constraint
  – What can be reused and recycled?
  – Criteria for reuse and recycle
  – Relevant facilities and activities (Process)
  – Constraint from international trade
Challenging issues
– consideration of long term safety

- Dilution/dispersion via isolation/containment
- Long-term management and safety assessment
  – Close to human activities
  – Large volume
  – Long half-lived radionuclide
- Time framework for long term control
- Disposal options, exempted or cleared as non-radioactive waste
Challenging issues
– regulating NORM residues/waste

• Remediation of sites contaminated by NORM residues. There are many legacy sites that have NORM residue contamination.

• Special attention to the graded approach to regulation (regulatory measures and resources commensurate with the risk) based on good knowledge and understanding of the diverse industrial sectors involved is needed for regulation of NORM industries including their residues.
3.1. The requirements for planned exposure situations apply to the following practices:

(f) the mining and processing of raw materials that involve exposure due to radioactive material;

3.4. Exposure due to natural sources is, in general, considered an existing exposure situation and is subject to the requirements in Section 5. However, the relevant requirements in Section 3 for planned exposure situations apply to:

(a) Exposure due to material\(^{17}\) in any practice specified in para.3.1 where the activity concentration in the material of any radionuclide in the uranium or thorium decay chains is greater than 1 Bq/g or the activity concentration of \(^{40}\)K is greater than 10 Bq/g.

*When the industrial practice is one where NORM residues > 1 Bq/g it becomes a practice subject to the requirements for planned exposure situations, and in turn some form of regulatory control.*
5.1. The requirements for existing exposure situations in Section 5 apply to:
(a) Exposure due to contamination of areas by residual radioactive material deriving from:
   (i) Past activities that were never subject to regulatory control or that were subject to regulatory control but not in accordance with the requirements of these Standards;

NORM residues, like any other radioactive residues, present an existing exposure situation when derived from past industrial activities that were not subject to adequate control.
BSS, Page 30, Footnote 17

A situation of exposure due to radionuclides of natural origin in food, feed, drinking water, agricultural fertilizer and soil amendments, construction materials and residual radioactive material in the environment is treated as an existing exposure situation regardless of the activity concentrations of the radionuclides concerned.

The reference to residual radioactive materials in the environment in Footnote 17 applies not only to NORM residues.
Exemption (GSR Part 3)

BSS, Schedule 1, Page 106

I-4. For radionuclides of natural origin, exemption of bulk amounts of material is necessary considered on a case by case basis\textsuperscript{60} by using a dose criterion of the order of 1 mSv in a year, commensurate with typical doses due to natural background levels of radiation.

Footnote 60. Material containing radionuclides of natural origin at an activity concentration of less than 1 Bq/g for any radionuclide in the uranium decay chain or the thorium decay chain and of less than 10 Bq/g for $^{40}$K is not subject to [i.e., excluded from] the requirements in Section 3 for planned exposure situations (para. 3.4(a)); hence, the concept of exemption from the requirements of these Standards does not apply for such material.

Footnote 60 implies that exemption does not apply to NORM residues $< 1$Bq/g because they are out of scope of planned exposure situations.
Clearance (GSR Part 3)

BSS, Schedule 1, Page 109.

I.12. Radioactive material within a notified practice or an authorized practice may be cleared without further consideration provided that:

(c) For radionuclides of natural origin in residues that might be recycled into construction materials, or the disposal of which is liable to cause the contamination of drinking water supplies, the activity concentration in the residues does not exceed specific values derived so as to meet a dose criterion of the order of 1 mSv in a year, which is commensurate with typical doses due to natural background levels of radiation.

*Generic clearance level for NORM in Schedule 1 of BSS is 1 Bq/g.*
Scope of regulation for NORM residues as per BSS

- Past practices are an existing exposure situation (Section 5 of BSS).
- Exemption dose criterion for NORM residues: of the order of 1 mSv/a
- Generic clearance level <1 Bq/g (U and Th decay chain), 10 Bq/g for $^{40}$K
- Specific clearance values derived to meet a dose criterion of the order of 1 mSv/a
NORM waste - disposal

If a NORM residue is declared to be radioactive waste, the applicable safety standards apply.

SSR-5, Page 13.

For disposal of radioactive waste to comply with the public dose limit of 1 mSv/a, a disposal facility (considered as a single source) is so designed that the calculated dose or risk to the representative person who might be exposed in the future as a result of possible natural processes affecting the disposal facility does not exceed a dose constraint of 0.3 mSv in a year or a risk constraint of the order of $10^{-5}$ per year.
DS459 Management of Radioactive Residues from Uranium Production and Other NORM Activities

1. Introduction
2. Overview of NORM Residues
3. Governmental, legal and regulatory framework
4. Protection of people and the environment
5. System for regulatory control
6. Strategies for NORM residue management
7. The safety case and safety assessment for NORM residues management
8. Safety consideration for long term Management of NORM Residues

Appendix A. Special considerations of residues from uranium production
Appendix B. Residue management plan for uranium production
Appendix C. Decommissioning plan for uranium production facility

References
Annex I. Residue be assessed for possible regulatory control
Annex II. Reuse and Recycling of NORM Residues
Annex III. Sampling and determining radionuclide activity concentrations
Annex IV. Bibliography
Activities with residues of concern

- Uranium mining and processing
- Rare earths extraction
- Thorium extraction & use
- Niobium extraction
- Non-U mining
- Oil and gas
- TiO₂
- Phosphates
- Zircon & zirconia
- Metals production (Sn, Cu, Al, Fe, Zn, Pb)
- Burning of coal etc.
- Water treatment
- Reuse/recycle
- Disposal
- Decommissioning/closure
- Plus +++

Growing interaction between operator and regulatory body

- Out of scope
- Evaluation of national situation
- NORM Practices
- Notification
- Exemption
- Authorization
- Exempted Practice
- Registration

Clearance

Reuse/recycle Landfill
System for Regulatory Control

Other facilities and activities and scoping criteria

Notification

Used in construction materials

Construction material requirements

≥ 1 Bq/g

Screening Assessment

*Meet dose criterion

NO

Registration or License

- Clearance
- Reuse and recycle
- Disposal in landfill
- Disposal as radioactive waste
- Long term management facility

YES

Exemption

License

Uranium production

* Dose criterion can be in the order of 1 mSv/y or other that is defined by the regulatory body.
Management options for NORM residues under authorized activities

Residues in authorized facility

Non-radioactive Material

Yes

Generic clearance

Yes

Reuse/recycle

No

Specific clearance

Yes

Landfill

No

NORM waste

Remains under regulatory control
Options for long term management

- NORM Waste
  - Large volume
  - Medium volume
  - Small volume
    - Specialist facility
    - Mixed land fill
    - Radioactive waste disposal
Future activities

• The DS459 will be further developed with incorporation of Member States’ comments

• Additional documents and activities need to be established to support the use of DS459:
  – TM on Application of the Graded Approach to Safety for Management of NORM Residues, Vienna, Austria, from 19 to 23 June 2017
  – Safety Reports on identification, reuse, safety assessment, decommissioning and disposal
  – Safe Uranium Production and NORM Activity Regulatory Forum (SUNREG Forum)
Thank you!